US-PAT-NO: 6181992

DOCUMENT-IDENTIFIER: US 6181992 B1

TITLE: Automotive diagnostic service tool

with hand held tool

and master controller

DATE-ISSUED: January 30, 2001

INVENTOR-INFORMATION:

NAME

STATE ZIP CODE COUNTRY

Gurne; Krzysztof Warren MI

N/A N/A

Williams; Raymond J. Farmington Hills MI

N/A N/A

Boldt; John R. Troy MI

N/A N/A

Barker; Robert L. Auburn Hills MI

N/A N/A

Broniak; Gregory J. Oxford MI

N/A N/A

Marus; Daniel J. Rochester Hills MI

N/A N/A

ASSIGNEE INFORMATION:

NAME CITY STATE

ZIP CODE COUNTRY TYPE CODE

Chrysler Corporation Auburn Hills MI

N/A N/A 02

APPL-NO: 08/ 431130

DATE FILED: April 28, 1995

PARENT-CASE:

This is a division of U.S. patent application Ser. No.

08/083,050, filed

Jun. 25, 1993 now U.S. Pat. No. 5,541,840.

INT-CL: [07] G01M015/00

US-CL-ISSUED: 701/29, 701/35 US-CL-CURRENT: 701/29, **701/35** FIELD-OF-SEARCH: 364/424.03; 364/424.04; 364/431.04; 364/551.01 ; 340/825.5 ; 701/29 ; 701/30 ; 701/31 ; 701/33 ; 701/34 ; 701/35 ; 701/102 REF-CITED: U.S. PATENT DOCUMENTS PAT-NO ISSUE-DATE PATENTEE-NAME US-CL May 1984 Re31582 .Hosaka et al. 364/431.04 N/A N/A 4207611 June 1980 Gordon 364/580 N/A N/A 4234921 Kinoshita et al. November 1980 364/431.01 N/A N/A4375672 March 1983 Kato et al. 364/431.04 N/AN/A 4602127 July 1986 Neely et al. 379/68 N/A N/A 4694408 September 1987 Zaleski 364/551.01 N/AN/A 4706082 November 1987 Miesterfeld et al. 340/825.5 N/A N/A4719458 January 1988 Miesterfeld et al. 340/825.5 N/A4739323 April 1988 Miesterfeld et al. 340/825.5 N/A N/A4739324 April 1988 Miesterfeld et al. 340/825.5 N/AN/A4796206 January 1989 Boscove et al. 364/551.01 N/A N/A4831560 May 1989 Zaleski 364/551.01 N/A N/A 4853850 August 1989 Krass, Jr. et al. 364/424.04 N/A N/A4866616 Takeuchi et al. September 1989 364/425.04 N/AN/A 4962456 October 1990 Abe et al.

N/A

N/A

364/431.01

	October 1990	Abe et al.
	364/431.01 N/A	N/A
4975846	December 1990	Abe et al.
	364/424.03 <b>N/A</b>	N/A
4975847	December 1990	Abe et al.
	364/424.03 N/A	N/A
5003476	March 1991	Abe
	364/424.03 <b>N/A</b>	N/A
5003477	March 1991	Abe et al.
	364/424.03 N/A	— N/A
5056023	October 1991	Abe
	364/424.03 <b>N/A</b>	N/A
5058044	October 1991	Stewart et al.
	364/551.01 N/A	N/A
5077670	December 1991	Takai et al.
	364/424.03 <b>N/A</b>	N/A
5107428	April 1992	Bethencourt et al.
	364/424.04 N/A	N/A
5132905	July 1992	Takai et al.
	364/424.03 <b>N/A</b>	N/A
5278759	January 1994	Berra et al.
	364/424.01 N/A	N/A
5365436	November 1994	Schaller et al.
	364/424.03 <b>N/A</b>	N/A

## OTHER PUBLICATIONS

Chrysler 1983-1988 Instruction Manual, OTC Tool & Equipment Division Sealed Power Corporation, Feb. 1988, entire book.

1990 Domestic 3 in 1 Monitor 4000E Manual, OTC Tool & Equipment Division SPX Corporation, Apr. 1990, entire book.

MPSI Pro-Link 9000 Maunal for Chrysler System (1988).

Chrysler Reference Manual for Snap-On Scanner and 1990 Supplement.

ART-UNIT: 361

PRIMARY-EXAMINER: Nguyen; Tan

ATTY-AGENT-FIRM: Calcaterra; Mark P.

ABSTRACT:

The present invention relates to a system and method for diagnosing and

isolating problems and for monitoring operting conditions on an automobile.

The system includes a hand held unit and a master station which can operate

alone or in unison to accomplish functions such as logging and displaying data

on a real-time basis, logging data remotely and displaying the data at a later

time, diagnosing fault conditions, monitoring operating parameters,

reprogramming on-board vehicle controllers, displaying service manual and

service bulletin pages and ordering parts on-line.

17 Claims, 18 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 14

----- KWIC -----

Application Filing Date - AD (1): 19950428

Detailed Description Text - DETX (6):

The vehicle interface capabilities of the hand held unit will now be

described in greater detail. The vehicle interface connector 42 is a

thirty-six way connector. The hand held unit 10 is interfaced to the vehicle

12 via the vehicle interface cable 16. In this embodiment, the vehicle

interface 44 is adapted to work with a variety of interface cables.

Specifically, six different types of cables are currently supported. All of

these cables, while utilizing the same thirty-six way interface, support

different communication protocols. For example, an ISO 9141/CARB cable is an

## asynchronous full duplex serial communication link configurable to a variety of

baud rates, such as 976, 7812.5, 62.5K, and 10.4K baud rates, with signal

levels varying between an idle condition of twelve volts and zero volts.

Similarly, an SCI-I cable is an asynchronous duplex serial communication link

configurable to baud rates such as 976, 7812.5, and 62.5K baud, with the signal

levels varying from an idle of zero volts to five volts. Both the SCI-I and

ISO 9141/CARB communication links utilize the standard ten bit non return to

zero (NRZ) data format, with one start bit, eight data bits and one stop bit.

Yet another cable communicates using a contention-based, class B multiplexed

bus, transferring data at 7812.5 baud via a voltage differential generated

across the bus which is biased to 2.5 volts.

Detailed Description Text - DETX (8):

The actual architecture of the hand held unit's controller can be found in

FIG. 4. As shown here, there are two microcomputers on board, an ST9 50 and an

MC68332 (not shown). The ST9 microcomputer, commercially available from S. G.

Thomson of Texas, is the communications coprocessor while the MC68332

microcontroller, available from Motorola of Illinois, performs the diagnostic

and data gathering features. The ST9 controller has A-D converters 52 for

measuring and scaling information from the vehicle interface connector, and has

addressing and data control buffers 54-60 for communicating with the MC68332

controller. Likewise, the MC68332 has interface buffers and A-D converters.

Here, both regular speed and high speed A-D converters are used to ensure the

data gathering process is rapid and accurate. On board, the hand held unit has

4.5 megabytes of memory. One 250K block of memory is the boot  $\underline{\mathsf{ROM}}_{,}$  which can

be reprogrammed, or "flashed", to alter the operation of the hand held unit.

The boot memory contains the operating system and device drivers used by the

band held unit. Another 250K block of memory is pseudo-static memory with a

ninety-six hour <a href="storage">storage</a> life. This memory is used for storing specialized

diagnostic routines that have been downloaded to the hand held unit, and for

storing customized data gathering templates. Another 1 Mb block of memory is

also flashable, and **stores** the diagnostic procedure information. This memory

can be reflashed via the master station link 18 from the master station 14 or

can be reflashed using a memory expansion card in one of the expansion slots

31, 48 or via the RS232 serial link 40. Another 1 Mb block of memory is pseudo

static memory with an eight hour life. This memory, like the ninety six hour

life memory, is used to  $\underline{\textbf{store}}$  information such as specialized diagnostic

routines. The final 2 Mb block of memory is RAM.

Detailed Description Text - DETX (22):

The hand held unit is also capable of downloading information to the vehicle

controllers for the purpose of updating these controllers. For example, most

controllers utilize a combination of  $\underline{\mathsf{ROM}}$  and RAM. The  $\underline{\mathsf{ROM}}$  contains the control

algorithm and calibration parameters, while the RAM contains operational

parameters. When controllers were first being used on automobiles, the ROM was

hard coded, that is, the <u>ROM</u> was fixed and unchangeable. Likewise, RAM was

volatile and any information  $\underline{\textbf{stored}}$  in RAM would be lost if the controller

power supply was interrupted. Today, automotive controllers rely upon a

combination of hard coded and erasable  $\underline{\mathsf{ROM}}$  in addition to RAM. The erasable

ROM usually contains information such as calibration

parameters. Frequently, after a vehicle has been introduced into production, knowledge learned after use of the vehicle by customers in the field will necessitate a change in calibration parameters. Rather than requiring the entire controller to be removed and replaced or the memory chips to be removed and replaced, storing calibration parameters in erasable ROM allows the calibration parameters to be rewritten. Here, the hand held unit has the capability to write, or "flash", erasable memory on the vehicle controllers. To accomplish this, the hand held unit has, stored in its own internal memory, the new information to be downloaded to the vehicle controller. The technician enters the **flash** programming mode by selecting the appropriate menu item from the display screen. Once this mode is selected, the hand held unit sends a control message to the controller to inquire as to the version and model number of the controller's memory. Upon receiving the response from the vehicle controller, the hand held unit determines whether or not the vehicle controller's memory needs to be updated. If the memory does need to be updated, the technician is presented with a screen indicating so and asking the technician whether or not he wishes to proceed. Assuming the technician has indicated his desire to proceed by pressing the yes key, the hand held unit sends the commands to the vehicle controller necessary to reconfigure the programmable ROM to reflect the new calibration values. The process of sending the appropriate commands and calibration data to a vehicle controller and verifying that the information has been correctly received and stored is well within the grasp of one of ordinary skill in the art, and therefore will not be described in detail herein. Once

the commanding,  $\underline{\text{writing}}$  and verification process has been completed, the hand held unit displays to the technician whether or not the

vehicle controller update procedure has been successful.

Detailed Description Text - DETX (40):

The master station 14 is designed to work in cooperation with the hand held

unit in performing sophisticated diagnostic procedures and the like, and can

operate independently of the hand held unit as a reference resource for the

service technician. The master station itself is approximately 41/4 feet tall,

with a base dimension of approximately 36 inches by 24 inches. The heart of

the master station is an IBM-compatible computer with an internal hard drive.

The master station also includes a 19 inch monochrome video monitor 100 for

graphics display, a keyboard 102, a floppy disk drive and CD-ROM drives 104,

and communication cables 18. The master station cart 106 has casters 108 at

the base for allowing the station to be rolled from place to place. The

internal memory of the computer contains the master station operating system,

while the CD-ROM drives are used to  $\underline{store}$  service and diagnostic information

and the like. The floppy disk drive accepts standard 31/2 inch disks and is

used for things such as swapping information between stations and for

performing backups and **storing** seldom used information, while the larger

capacity hard drive is used for **storing** information such as diagnostic results

and customized test procedures. The master station can operate alone or in

conjunction with the hand held unit 10. Specifically, regardless of whether

the master station 14 is connected to the hand held unit, the master station is

capable of operating as a technical information library, parts catalog and host

update link. However, when connected to the hand held unit, the master station is also capable of acting as a data recorder, diagnostic

station, and hand held

unit update host. The master station, besides having a GPIB interface for

communicating with the hand held unit, also has an RS-232 interface for

communicating with other service tools. In this embodiment, earlier generation

hand held units communicated only via RS-232. Therefore, the master station of

the present invention can communicate with older units via the RS-232 while

also communicating with the hand held unit via the GPIB link.

## Detailed Description Text - DETX (43):

The master station obviates the need for printed paper manuals and service

bulletins through its technical information library mode. In this mode, the

technician can access service manuals and service bulletins, which are **stored** 

on the CD-ROM's, for display on the monitor. This mode has several benefits.

First is the advantage of obviating the need for paper manuals and service

bulletins, which often become torn, soiled and lost over time. Also, because

the information is **stored** electronically and retrieved only as needed, there is

no need to have book shelves for **storing** these items. Moreover, as information

changes and requires updates, new "pages" can be added electronically by

updating the CD-ROM without requiring the technician to physically insert pages

into a printed manual. Updating technical information can also be accomplished

by supplementing the information on the CD-ROM's through information stored on

floppy disks, as well as information available via telecommunication download

links, such as modems. In this embodiment, the master station can be connected

to any conventional phone line for communicating with a

remote host computer for downloading update information. Once the information is downloaded into the master station, the updated information can be **stored** in the internal memory of the master station or on a floppy disk. By allowing updated information to be provided via these different methods, the master station technical information library can be easily maintained in an up to date state.

Detailed Description Text - DETX (62): After having proceeded through the fault diagnosis procedure without yet locating the problem, the technician turns to the master station to access the technician information library for more assistance. Using the keyboard on the master station, the technician enters the vehicle type and model year to see if a service bulletin has been issued regarding this problem. The master station searches its CD-ROM data base for a relevant bulletin and presents the information to the technician on the monitor. In this example, the bulletin informs the technician that problems such as this have indeed been experienced in the field, and a new diagnostic procedure has been provided. Upon learning this, the technician connects the hand held unit to the master station via the communication link and, using the keyboard, request the master station to download the new diagnostic procedure to the hand held unit. The master station relays the information to the hand held unit, and the new diagnostic procedure is stored in the hand held unit's eight hour memory. The technician

Detailed Description Text - DETX (66):

Having successfully diagnose the problem, the technician then updates the

then begins executing the new diagnostic procedure.

engine computer to erase the fuel error air fault flag and enter the service

information. He reconnects the hand held unit to the vehicle, and clears the

codes. Next, as shown in FIG. 17, he enters his ID number, the VIN number, the

service order number and the mileage in hand held unit and flash programs the

information into the engine controller's service log memory. Before letting

the car be released to the customer, the technician checks to see if there are

any service bulletins indicating an interim calibration update has been

released. Checking the technical library, he learns that there has been a new

set of anti-lock calibrations released. The technician places a memory module

with the new calibrations into the expansion slot of the hand held unit. As

shown in FIG. 18, the technician can load update calibrations into the hand

held unit using a memory card or the master station. Next, the technician

queries the car's antilock controller to see if it has the latest set of

calibrations. The controller responds that it currently it running "version

3.01b" calibrations. The hand held unit indicates to the technician that there

are newer calibrations in the memory card, and asks him if he would like to

proceed with downloading these new calibrations to the anti-lock controller.

He responds "yes", and the hand held tool  $\underline{programs}$  the anti-lock controller's

<u>flash</u> memory with the new calibrations. The controller sends a message to the

hand held tool, which is displayed for the technician, indicating the update was successful.

## Related Application Filing Date - RLFD (1): 19930625

Current US Cross Reference Classification - CCXR (1):